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AERODYNAMIC CHARACTERISTICS AND STORE LOADS OF THE 1/24-SCALE F--ETC(U)
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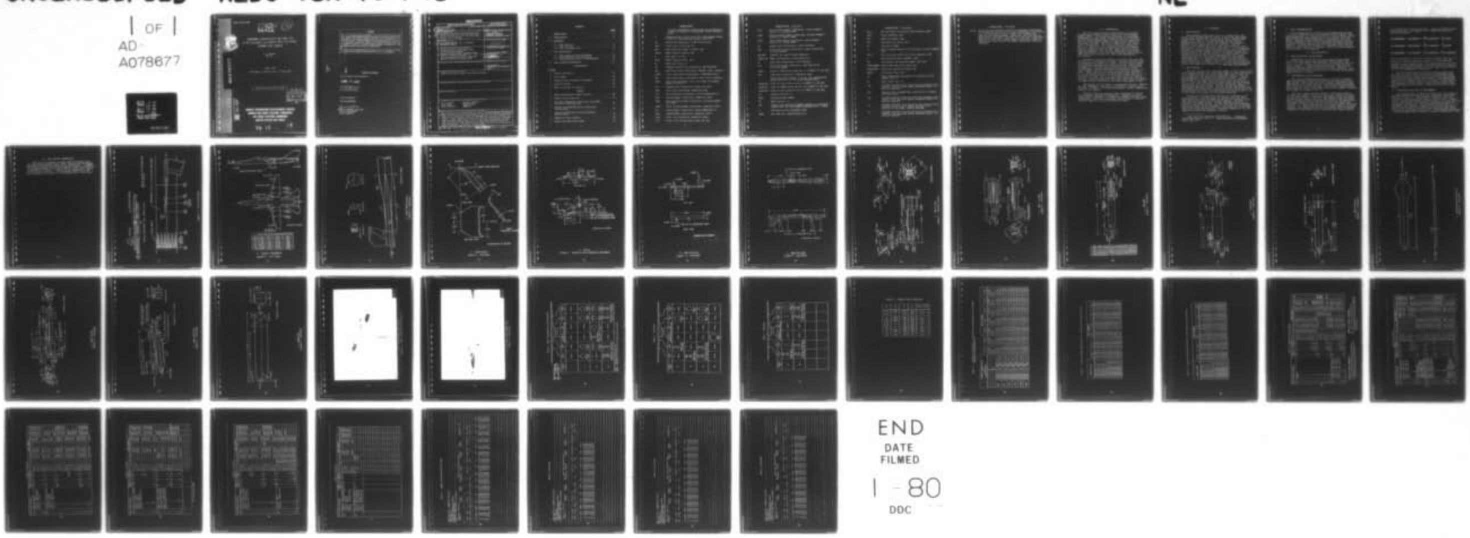

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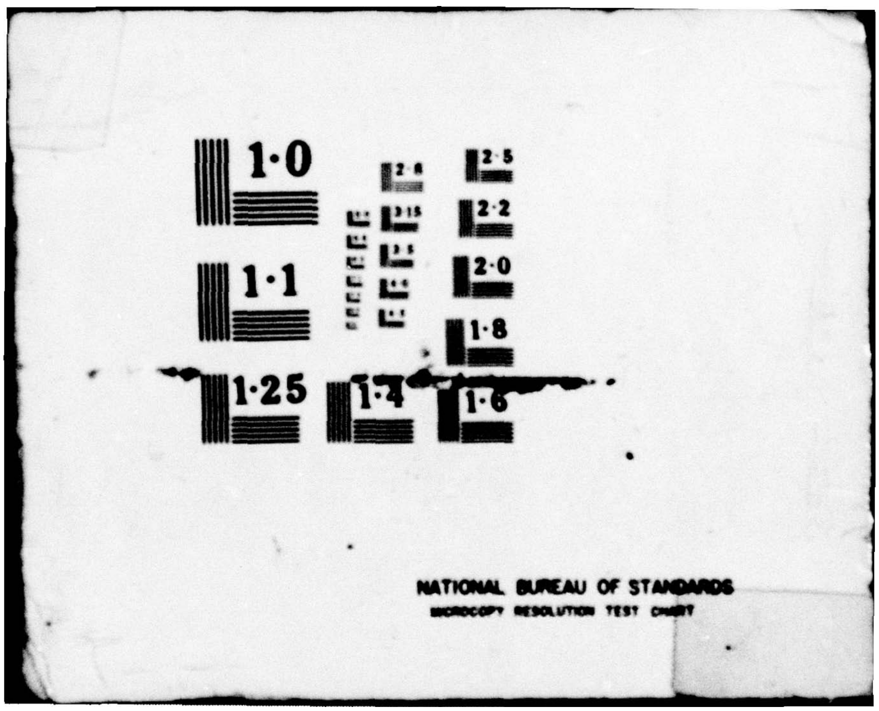
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LEVEL II (2)

AERODYNAMIC CHARACTERISTICS AND STORE LOADS OF THE 1/24-SCALE F-111 AIRCRAFT MODEL WITH SEVERAL EXTERNAL STORE LOADINGS

C. F. Anderson
ARO, Inc

August 1979

Final Report for Period 18 June - 23 June, 1979

ARNOLD ENGINEERING DEVELOPMENT CENTER
ARNOLD AIR FORCE STATION, TENNESSEE
AIR FORCE SYSTEMS COMMAND
UNITED STATES AIR FORCE

APPROVAL STATEMENT

This report has been reviewed and approved.

Walter P. West

WALTER P. WEST, Capt, USAF
Test Director, PWT Division
Directorate of Test Operations

Approved for publication:

FOR THE COMMANDER

James D. Sanders

JAMES D. SANDERS, Colonel, USAF
Director of Test Operations
Deputy for Operations

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Store Loads	External Store
Static Stability	TAWDS Pod

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The 1/24-scale F-111 aircraft model was tested ~~in the Aerodynamic Wind Tunnel (4T)~~ to obtain simultaneous measurements of the aircraft and store aerodynamic loads and to evaluate the effects of the TAWDS pod on aircraft stability and control. Static stability and store loads data were obtained at 5 wing sweep angles for Mach numbers from 0.4 to 1.2. Data were also obtained for stabilizer deflections of ±10 deg and with the speed brake deflected 50 deg for some configurations. The angle of attack range was from -2 to 24 deg and the angle of sideslip range was from -10 to 10 deg.

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ILLUSTRATIONS

TABLES

NOMENCLATURE

Aircraft aerodynamic coefficients are referenced to a body axis system of coordinates unless otherwise noted

A	Reference area, (F-111 0.911 ft^2; rack-mounted stores 0.0123 ft^2; pylon-mounted stores 0.0031 ft^2)
AB	Nozzle plug base area, 0.0080 ft^2 per plug
ACAV	Cavity area, 0.0158 sq. ft.
AFA	Flow correction angle in pitch, deg.
ALPHA	Model angle of attack, deg.
B	Wing span, 31.5 in.
BETA	Model sideslip angle, deg.
BL	Model butt line, in.
CA	Forebody axial-force coefficient, CAT-CAB-CACAV
CAB	Base axial-force coefficient, -AB(PB1 + PB2 - 2P)/Q·A
CACAV	Cavity axial-force coefficient, -ACAV(PCAV-P)/Q·A
CAT	Total axial-force coefficient, total axial force/Q·A
CBAR	Wing mean aerodynamic cord, at 16 deg. wing sweep angle, 4.5208 in.
CDS	Forebody drag coefficient (stability axis)
CDTS	Total drag coefficient (stability axis)
CLL	Rolling-moment coefficient, rolling moment/Q·A· B
CLLS	Rolling-moment coefficient (stability axis)
CLMT	Total pitching-moment coefficient, pitching moment/ Q·A· CBAR
CLMTS	Total pitching-moment coefficient (stability axis)
CLN	Yawing-moment coefficient, yawing moment/Q·A· B
CLNS	Yawing-moment coefficient (stability axis)
CLTS	Total lift coefficient (stability axis)
CL-A	Slope of CLS versus alpha curve, per deg.

NOMENCLATURE - Continued

CLLX	Store rolling moment coefficient, rolling moment/(Q·A·D), X = pylon number
CLMX	Store pitching moment coefficient, pitching moment/(Q·A·D), X = pylon number
CLNX	Store yawing moment coefficient, yawing moment/(Q·A·D), X = pylon number
CN	Normal-force coefficient, normal force/Q·A
CNX	Store normal force coefficient, normal force/(Q·A), X = pylon number
CON SET	Constant set used for data reduction
CONFIG NO	Model configuration identification no.
CY	Side-force coefficient, side force/Q·A
CYX	Store side force coefficient, side force/(Q·A), X = pylon number
CLM-A	Slope of CLMT versus alpha for $-2 \leqq$ ALPHA $\leqq 6$, per deg.
CYS	Side-force coefficient (stability axis)
D	Store reference diameter, 1.500 in. for rack-mounted stores and 0.750 in. for pylon mounted stores
DCLLS/DCY	Slope of CLLS versus CY for $-4 \leqq$ BETA $\leqq 4$, per deg.
DCLM/DCL	Slope of CLMTS versus CLS for $-2 \leqq$ ALPHA $\leqq 6$, per deg.
DCLNS/DCY	Slope of CLNS versus CY for $-4 \leqq$ BETA $\leqq 4$, per deg.
FS	Fuselage station, in.
MACH	Freestream Mach number
MS	Model station, in.
NCP	Normal force center-of-pressure location in reference lengths from the model moment reference point, CLM/CN
P	Free-stream static pressure, psfa
PART	Run (data set) identification no.

NOMENCLATURE - Continued

PB1,2	Left and right nozzle plug base pressure, psfa
PCAV	Cavity pressure, psfa
PHI	Model roll angle, deg.
PHII	Indicated roll angle, deg.
PN	Data point number
PT	Total pressure measured in the tunnel stilling chamber, psfa
PTE1,2	Left and right nozzle exit total pressure, psfa
Q	Free-stream dynamic pressure, psfa
RE	Free-stream unit Reynolds number, per foot
SPEED BRAKE	Speed brake deflection angle, deg.
STABILATOR	Stabilator deflection angle, deg.
SWEEP	Wing sweep angle, deg.
TT	Total temperature measured in the tunnel stilling chamber, deg. F.
WL	Model water line, in.
X_{MT}	Transfer distance along the pylon axis system X-axis, measured from the pylon moment reference center, in., positive upstream
XNP	Neutral point, -DCLMTS/DCLS, positive aft of moment reference center
X_{NT}	Transfer distance along the pylon axis system X-axis, measured from the pylon moment reference center, in., positive upstream
Y_T	Transfer distance along the pylon axis system Y-axis, measured from the pylon moment reference, in., positive to the right, looking upstream
Z_T	Transfer distance along the pylon axis system Z-axis, measured from the pylon moment reference center, in., positive downward

NOMENCLATURE - Concluded

Note: The store sign convention used for aerodynamic coefficients is the same as used for the aircraft aerodynamic coefficients, i.e., as viewed by the pilot; normal force coefficient, positive up; pitching-moment coefficient, positive nose up; axial force coefficient, positive aft; side force coefficient, positive to the right; yawing moment coefficient, positive nose to the right; and rolling moment coefficient, positive clockwise.

1.0 INTRODUCTION

The work reported herein was conducted at the Arnold Engineering Development Center (AEDC), Air Force Systems Command (AFSC). The program was sponsored by the Armament Development and Test Center (SD20S), Eglin Air Force Base, Florida, under Program Element 65807F. The user agency was the Air Force Armament Laboratory (AFATL/DLJC), Eglin Air Force Base, Florida. The project monitor was Capt. Spence Peters of AFATL/DLJC. The test results were obtained by ARO, Inc., AEDC Division (a Sverdrup Corporation Company), operating contractor for the AEDC, AFSC, Arnold Air Force Station, Tennessee. The test was conducted in the Aerodynamic Wind Tunnel (4T) of the Propulsion Wind Tunnel Facility (PWT) from June 18 through 23, 1979, under ARO Project No. P41C-C4.

Aerodynamic forces and moments and store loads data were obtained on a 1/24-scale F-111 model. The data are to be used in verifying the suitability of the 1/24-scale aircraft model and associated external store models for store loads testing in Tunnel 4T. Data were also obtained for use in evaluating the effects of a Target Acquisition and Weapons Delivery System (TAWDS) pod on F-111 stability and control characteristics. Static stability and store loads data were obtained for 10 configurations over the Mach number range from 0.4 to 1.2 at angles of attack from -2 to 24 deg and angles of sideslip from -10 to 10 deg. The wing sweep angle was varied from 26 to 72.5 deg. Some configurations were also tested with the stabilator deflected ±10 deg and with the speed brake opened 50 deg.

The purpose of this report is to document the test, describe the test parameters, and provide information to permit use of the data. It does not include data analysis, which is beyond the scope of this report.

The data from this test have been transmitted to the Air Force Armament Laboratory (AFATL/DLJC). Requests for these data should be addressed to Armament Development and Test Center (ADTC/SC20S), Eglin Air Force Base, Florida 32542. A copy of the final data is on file on microfilm at AEDC.

2.0 APPARATUS

2.1 TEST FACILITY

The Aerodynamic Wind Tunnel (4T) is a closed-loop, continuous flow, variable-density tunnel in which the Mach number can be varied from 0.1 to 1.3 and can be set at discrete Mach numbers of 1.6 and 2.0 by placing nozzle inserts over the permanent sonic nozzle. At all Mach numbers, the stagnation pressure can be varied from 300 to 3,700 psfa. The test section is 4-ft square and 12.5-ft long with perforated, variable porosity (0.5- to 10-percent open) walls. It is completely enclosed in a plenum chamber from which the air can be evacuated, allowing part of the tunnel airflow to be removed through the perforated walls of the test section. The model support system consists of a sector and sting attachment which has a pitch angle capability of -8 to 28 deg with respect to the tunnel centerline and a roll capability of -180 to 180 deg about the sting centerline. A schematic showing the location of the F-111 model in the tunnel is shown in Fig. 1. A more complete description of the tunnel may be found in the Test Facilities Handbook.[1]

2.2 TEST ARTICLES

The test articles were 1/24-scale models of the F-111 aircraft, MK-20 Rockeye, MK-82SE, SUU-30H/B, GBU-15PWW, and GBU-15CWW stores, a retracted Pave Tack pod with attached ALQ119 pod, a data link pod, a TAWDS pod, and associated suspension equipment. Details and dimensions of the models are presented in Figs. 2 through 4. Photographs of the model installed in the tunnel are shown in Fig. 5. The F-111 model had flow-through ducts and was equipped with Type II inlets (no splitter plates) containing fixed 10-deg inlet spikes and nozzle plugs. The aft fuselage and exhaust nozzles were modified to allow insertion of the balance and sting. This modification resulted in a slight relocation of the data link pod as shown in Fig. 4h. The model stabilator could be set to -10, 0, and 10 deg with respect to an aircraft waterline.

Pylons with five-component balances were installed at the pivot stations (3 through 6) for all testing except for data obtained for the clean and TAWDS configurations. BRU-3A/A racks (Fig. 3c) were installed with various loadings of MK-82SE, SUU-30H/B, or Rockeye stores. A model representing the exposed portion of the retracted Pave Tack pod (Fig. 4f) with an attached ALQ-119 pod (Fig. 4g) was attached to the centerline of the fuselage at FS 12.638 when required. The store loadings for all configurations tested are presented in Table 1.

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[1]Test Facilities Handbook (Tenth Edition). "Propulsion Wind Tunnel Facility, Vol. 4." Arnold Engineering Development Center, May 1974.

2.3 TEST INSTRUMENTATION

Test instrumentation included a six-component main balance in the F-111 model and four five-component pylon balances. The pylon balances were an integral part of the pylons (metric pylons) and measured the loads transmitted to the pylons by the store models. Because of space constraints, axial-force links could not be incorporated into the pylon balances and hence, the axial loads for the pylon mounted store and store-rack models were not measured. Five pressure transducers connected to orifices were used to measure sting cavity pressure, nozzle plug base pressures, and nozzle exit total pressures.

3.0 TEST DESCRIPTION

3.1 TEST CONDITIONS AND PROCEDURE

Measurements of aircraft and pylon-mounted store steady-state forces and moments were obtained at Mach numbers from 0.4 to 1.2. The nominal test conditions set during the test are given in Table 2. Tunnel conditions were held constant while angle of attack or sideslip angle were varied. Data were recorded at selected angles using the pitch pause technique. Data were obtained at angles-of-attack from -2 to 24 deg and sideslip angles from -10 to 10 deg.

3.2 DATA REDUCTION AND CORRECTIONS

The force and moment data obtained on the F-111 aircraft model were reduced to coefficient form in the body and stability axes systems. Model base and cavity pressure measurements were made for the F-111 model and used to calculate base and forebody axial force and drag coefficients. The aircraft reference areas and lengths are noted in the Nomenclature and the moment reference point location is shown in Fig. 2.

The store loads data were reduced to coefficient form in the pylon axis system. The pylon longitudinal axis was parallel to the lower surface of the pylons and passed through the moment reference point shown in Fig. 3a. The reference area and length used to reduce the store loads data are noted in the Nomenclature. The moment reference point location for the store models was located at the pylon mid-lug point on the pylon balance centerline (see Fig. 3). Since there were no axial-force gages on the pylon balances, the transferring of the store moments from the balance centerline to any other point in the pylon axis system requires

an estimated axial-force coefficient. Using an estimated axial-force coefficient, the moments can be transferred using the following equations:

$$\mathrm{CLMX(TRANSFERRED)} = \mathrm{CLMS(TABULATED)} - \frac{X_{MT}}{D}\,\mathrm{CNX(TABULATED)} + \frac{Z_T}{D}\,\mathrm{CAX(EST)}$$

$$\mathrm{CLNX(TRANSFERRED)} = \mathrm{CLNX(TABULATED)} - \frac{X_{NT}}{D}\,\mathrm{CYX(TABULATED)} - \frac{Y_T}{D}\,\mathrm{CAX(EST)}$$

$$\mathrm{CLLX(TRANSFERRED)} = \mathrm{CLLX(TABULATED)} + \frac{Y_T}{D}\,\mathrm{CNX(TABULATED)} + \frac{Z_T}{D}\,\mathrm{CYX(TABULATED)}$$

where X represents a wing pylon balance and where X_{MT}, X_{NT}, Y_T, and Z_T are transfer parameters defined in the Nomenclature. CAX(EST) is the estimated axial-force coefficient for the store loading (positive down-stream). The sign convention used for the store aerodynamic coefficients is the same as that used for the aircraft aerodynamic coefficients.

The aircraft angles of attack and sideslip angles were corrected for sting deflections caused by aerodynamic loads. The flow angularity in the tunnel pitch plane was determined by testing the model upright and inverted. Flow angularities thus determined ranged from 0.09 to 0.15 deg for Mach numbers from 0.4 to 1.2 and were applied to the data. Corrections for the components of model weight, normally termed static tares, were also applied to the data for both the aircraft and store models.

3.3 UNCERTAINTY/PRECISION OF MEASUREMENTS

The estimated data uncertainties associated with Tunnel 4T measured tunnel conditions and model aerodynamic coefficients are given in Table 3. Representative store and store-rack coefficient uncertainties are given in Tables 4 and 5, respectively. Balance measurement uncertainties for all pylon balances were similar; hence, the coefficient uncertainties shown are typical for all balances. The estimated uncertainties in force and moment coefficients are based on a 95-percent confidence level. The tolerance for setting and maintaining Mach number during pitch or yaw polars was ±0.005. The estimated uncertainty in aircraft model angle of attack or sideslip angles was 0.1 deg.

4.0 DATA PACKAGE PRESENTATION

The final data package included tabulated summary data, data recorded on magnetic tape, model installation photographs, and model configuration identification photographs. A summary of the test program listing part numbers for each test condition is presented in Table 6. A sample of the summary data tabulations is given in Table 7. All parameters appearing on the data tabulation are defined in the Nomenclature of this report.

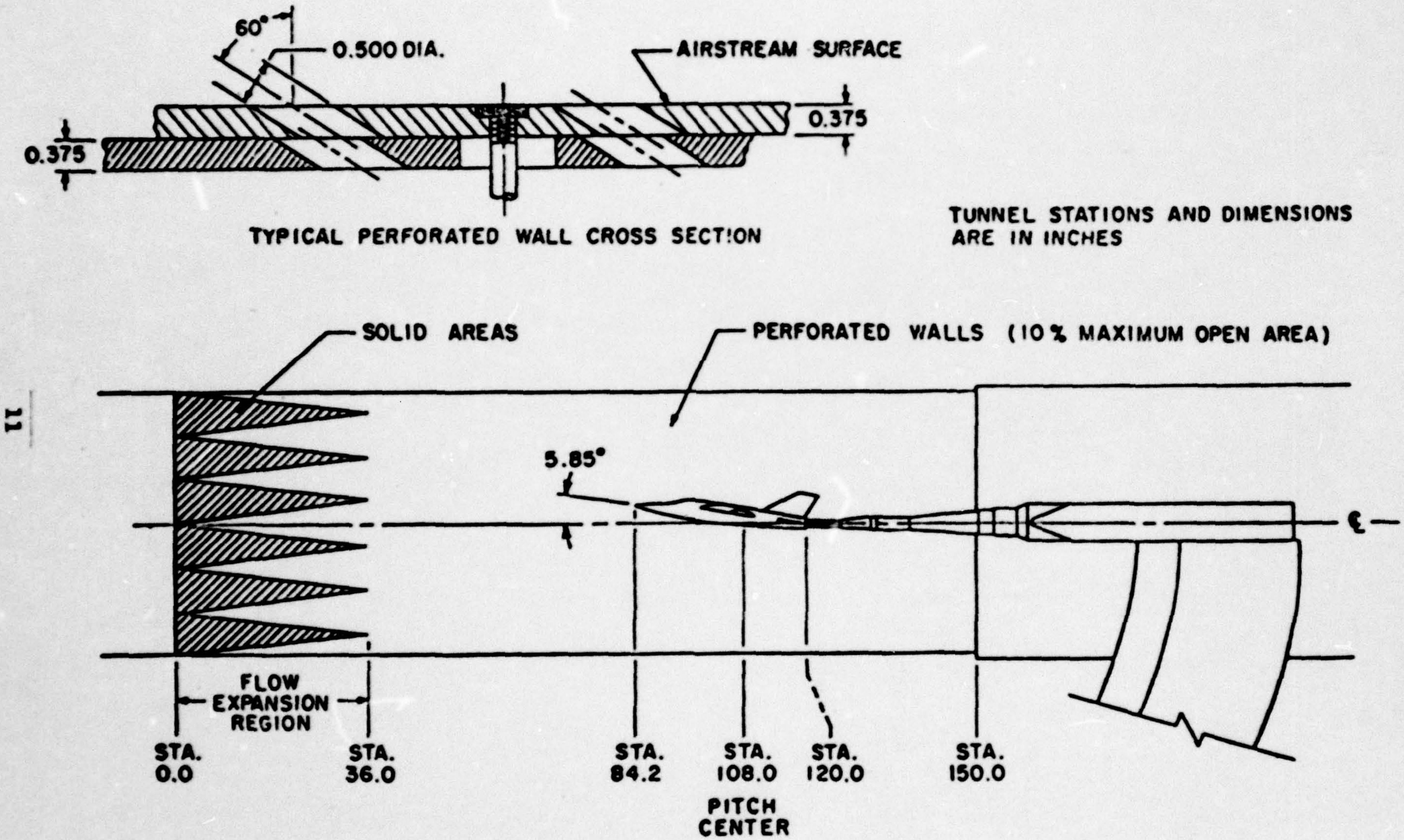
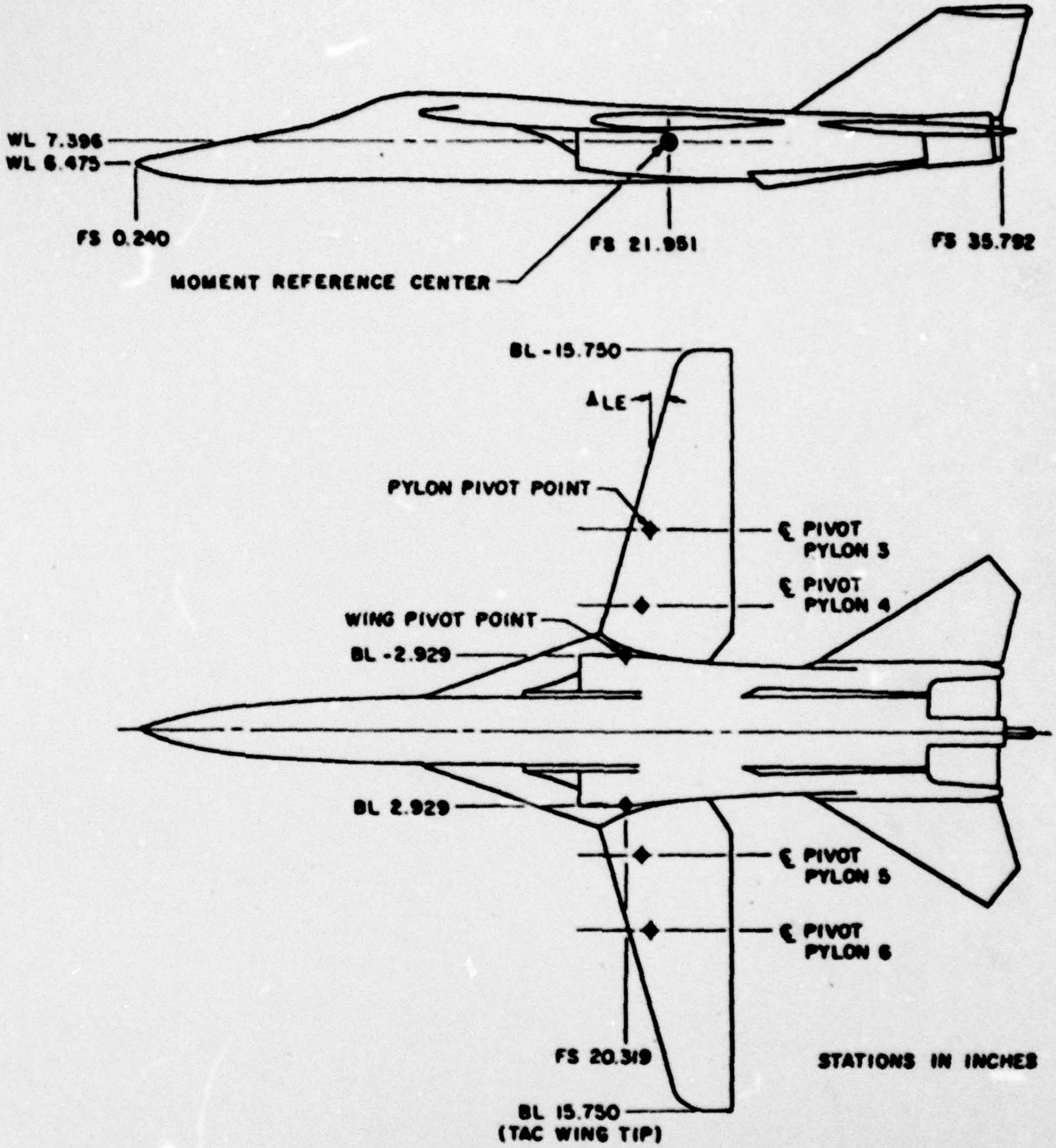


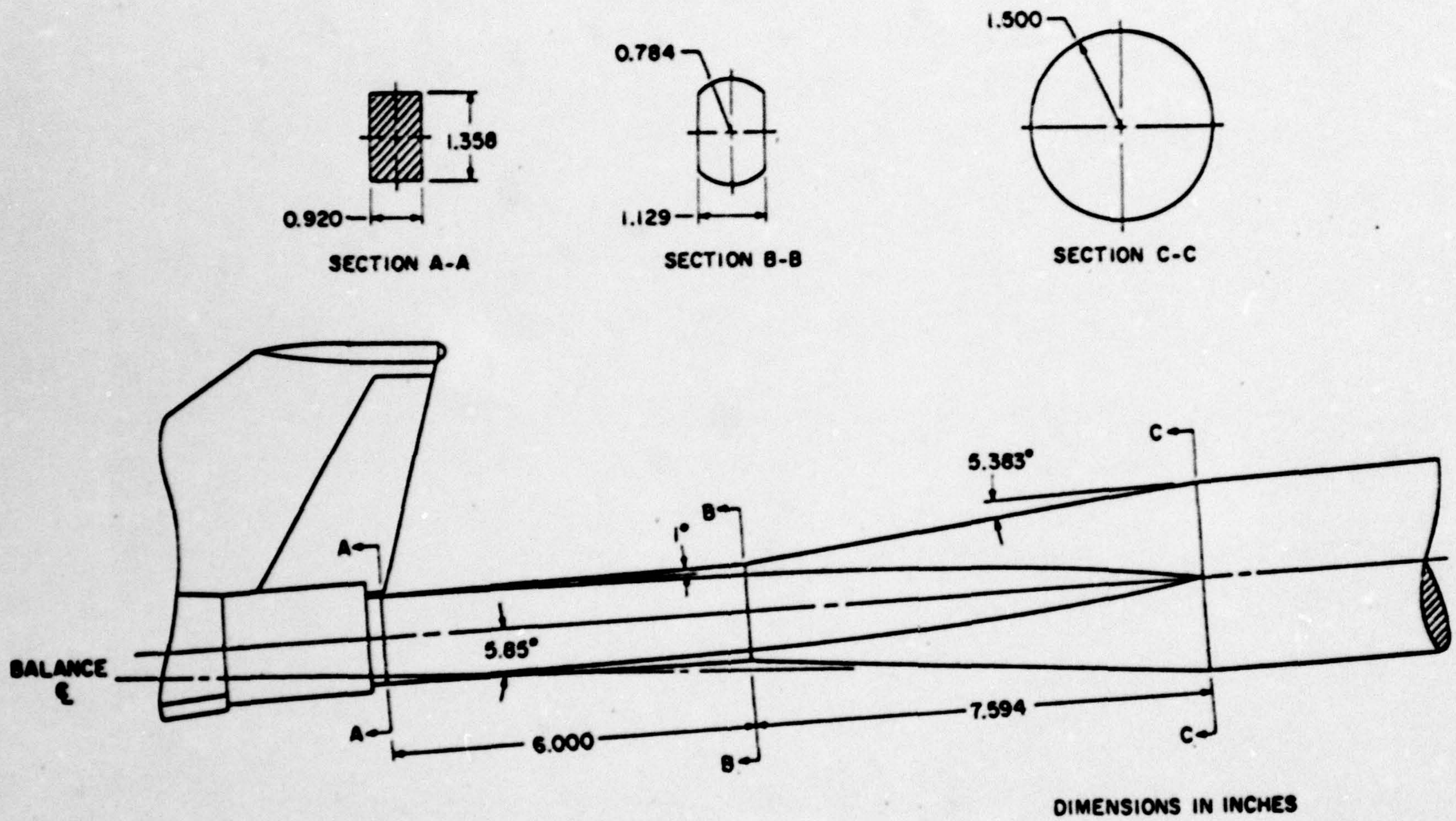
Figure 1. Tunnel Installation



Λ_{LE}	INBD PYLON POINT		OUTBD PYLON PIVOT POINT	
	FS	BL	FS	BL
16 (Ref)	20.962	4.913	21.291	7.873
26	21.297	4.771	22.135	7.629
45	21.843	4.352	23.566	6.782
54	22.047	4.096	24.129	6.226
60	22.160	3.910	24.452	5.810
72.5	22.238	3.488	24.978	4.847

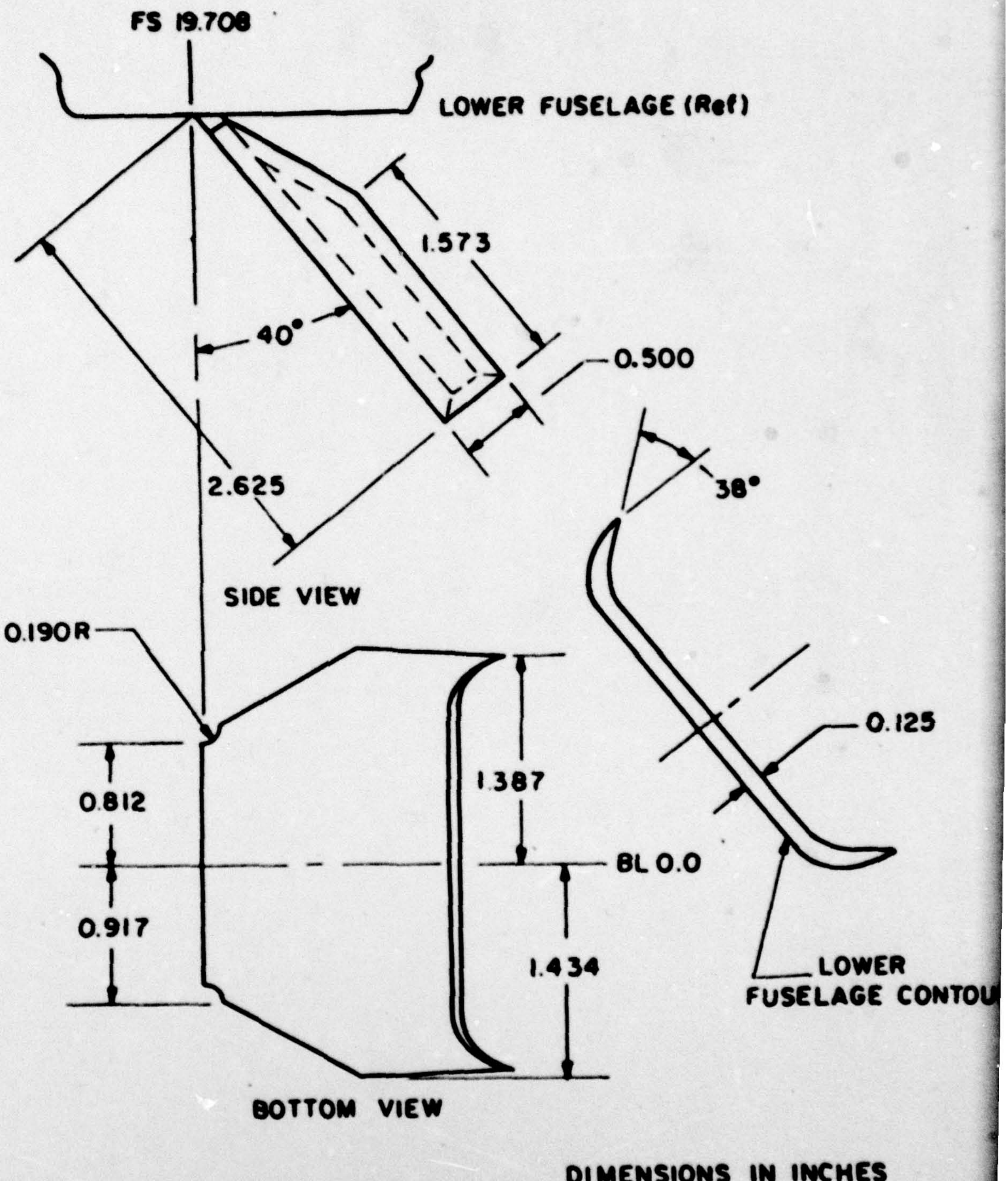
a. General Arrangement

Figure 2. F-111 Model



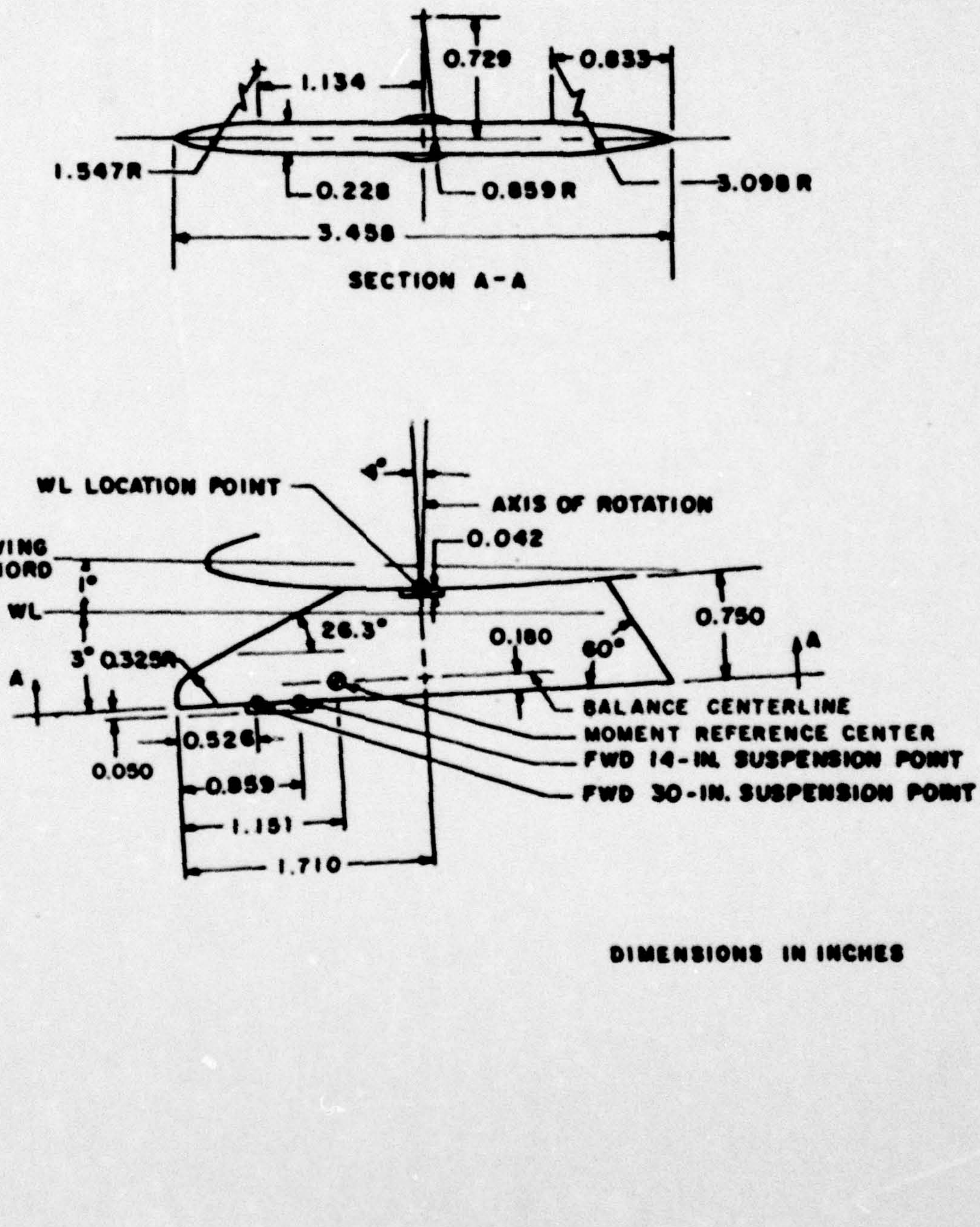
b. Model Base Details

Figure 2. Continued



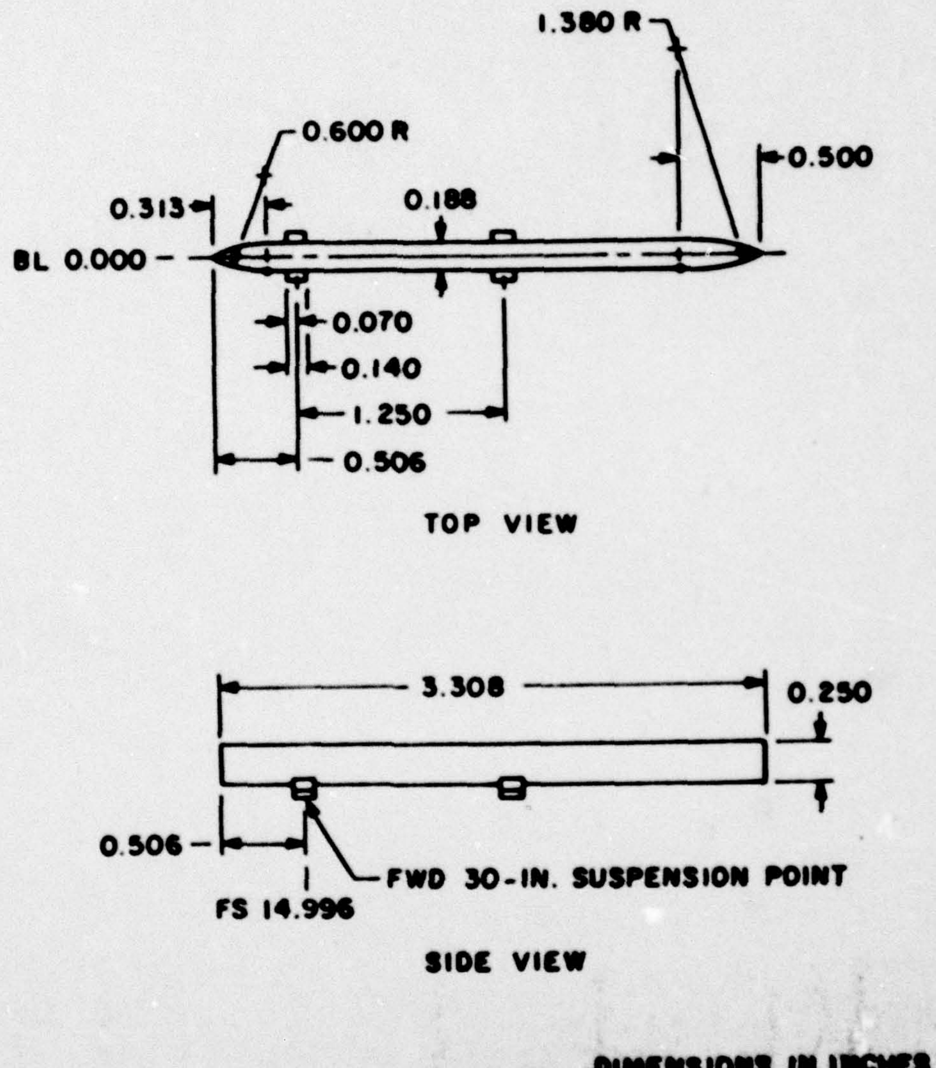
c. Speed Brake

Figure 2. Concluded



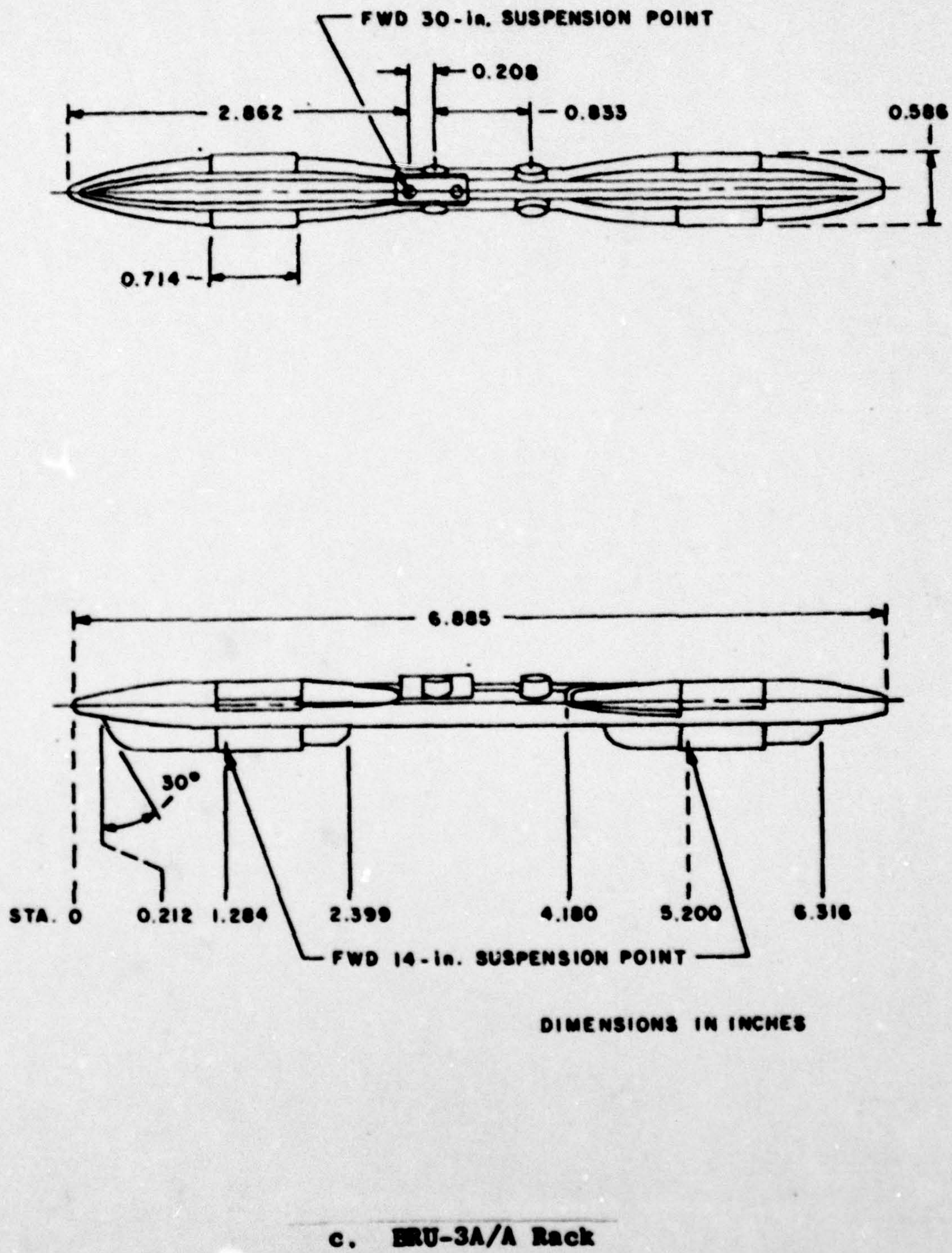
a. Pylon

Figure 3. External Store Suspension Equipment



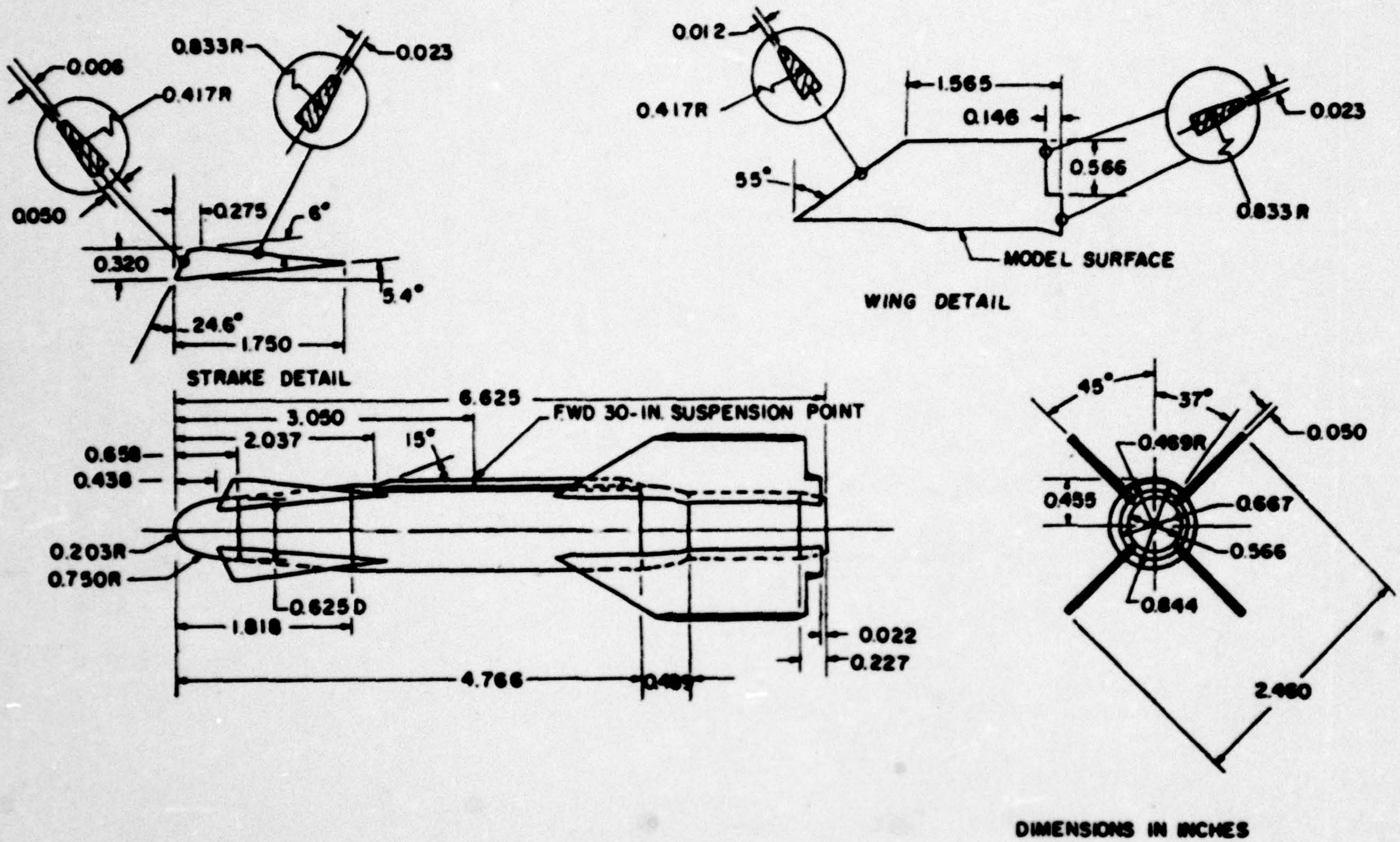
b. ALQ-119 Pylon

Figure 3. Continued



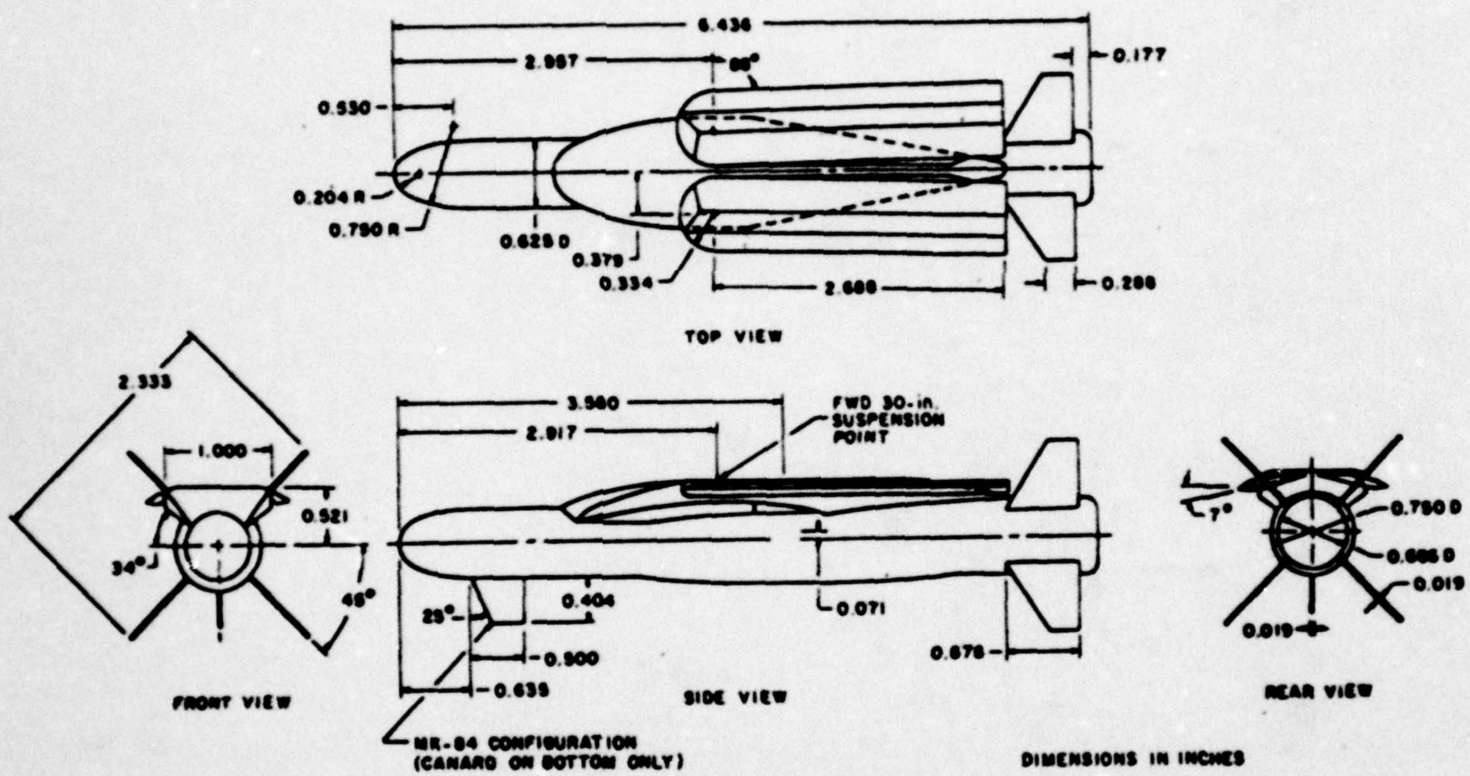
c. BRU-3A/A Rack

Figure 3. Concluded



a. GBU-15 CWW

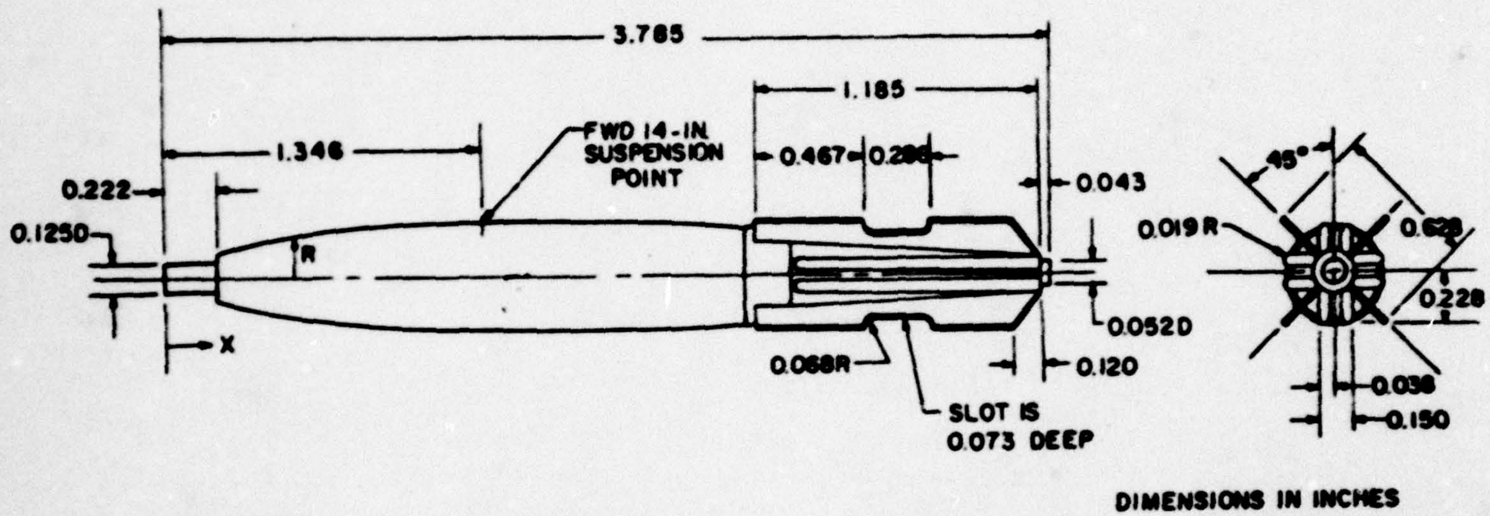
Figure 4. External Stores



b. GBU - 15 PWW

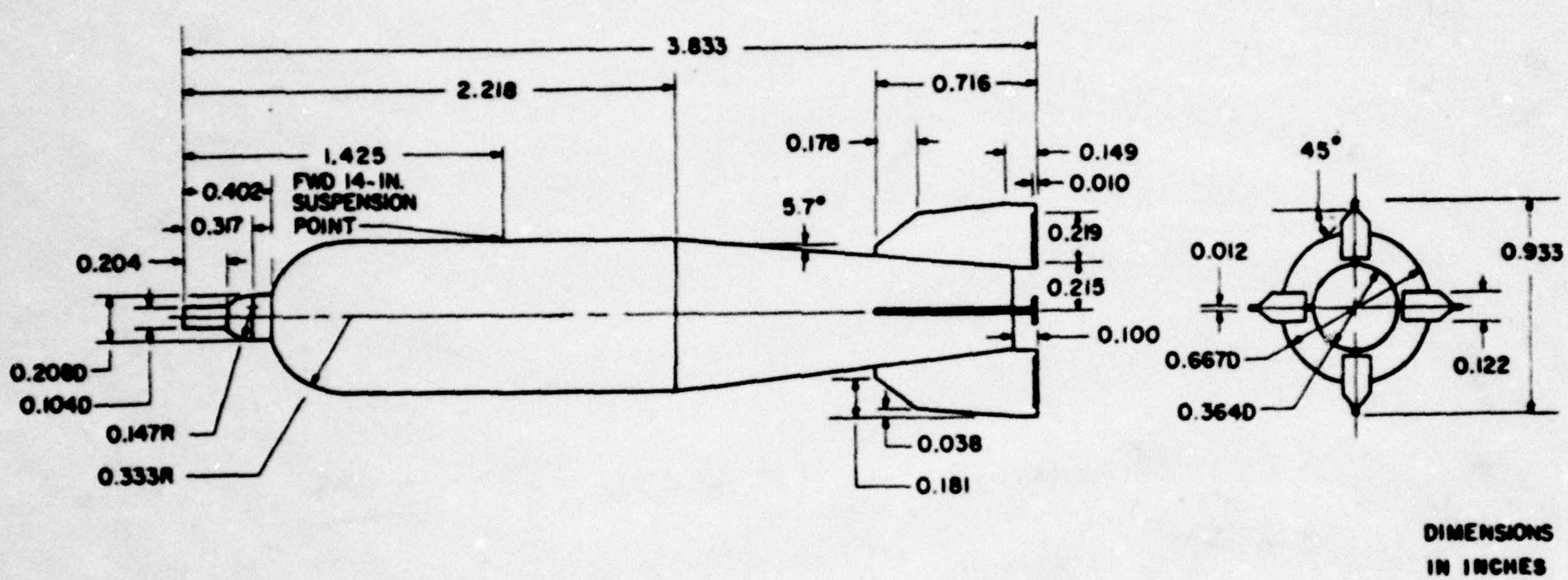
Figure 4. Continued

X, in.	R, in.
0.222	0.096
0.297	0.117
0.357	0.130
0.485	0.154
0.656	0.177
0.826	0.195
0.997	0.209
1.168	0.220
1.338	0.224
CONST DIAM	
1.893	0.224
2.063	0.222
2.234	0.216
2.404	0.206
2.479	0.201
2.479	0.209
CONST SLOPE	
2.675	0.210
CONST SLOPE	
3.440	0.088
CONST DIAM	
3.742	0.088



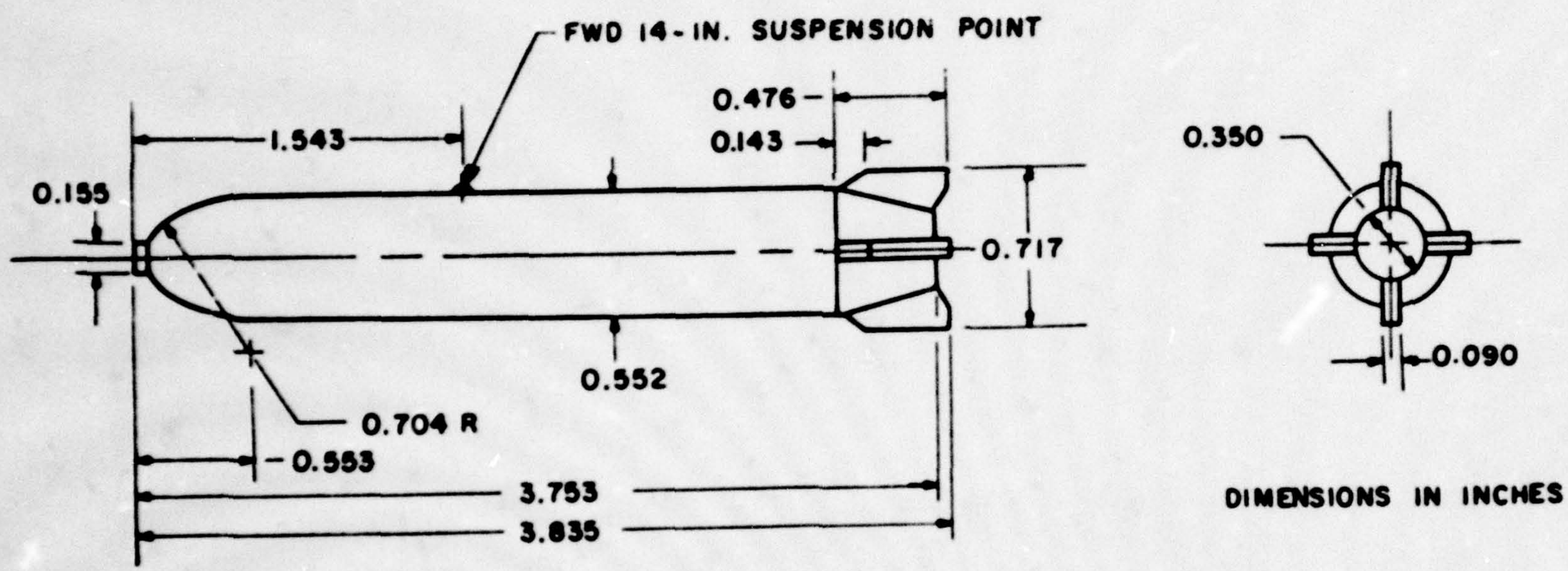
c. MK-82SE

Figure 4. Continued



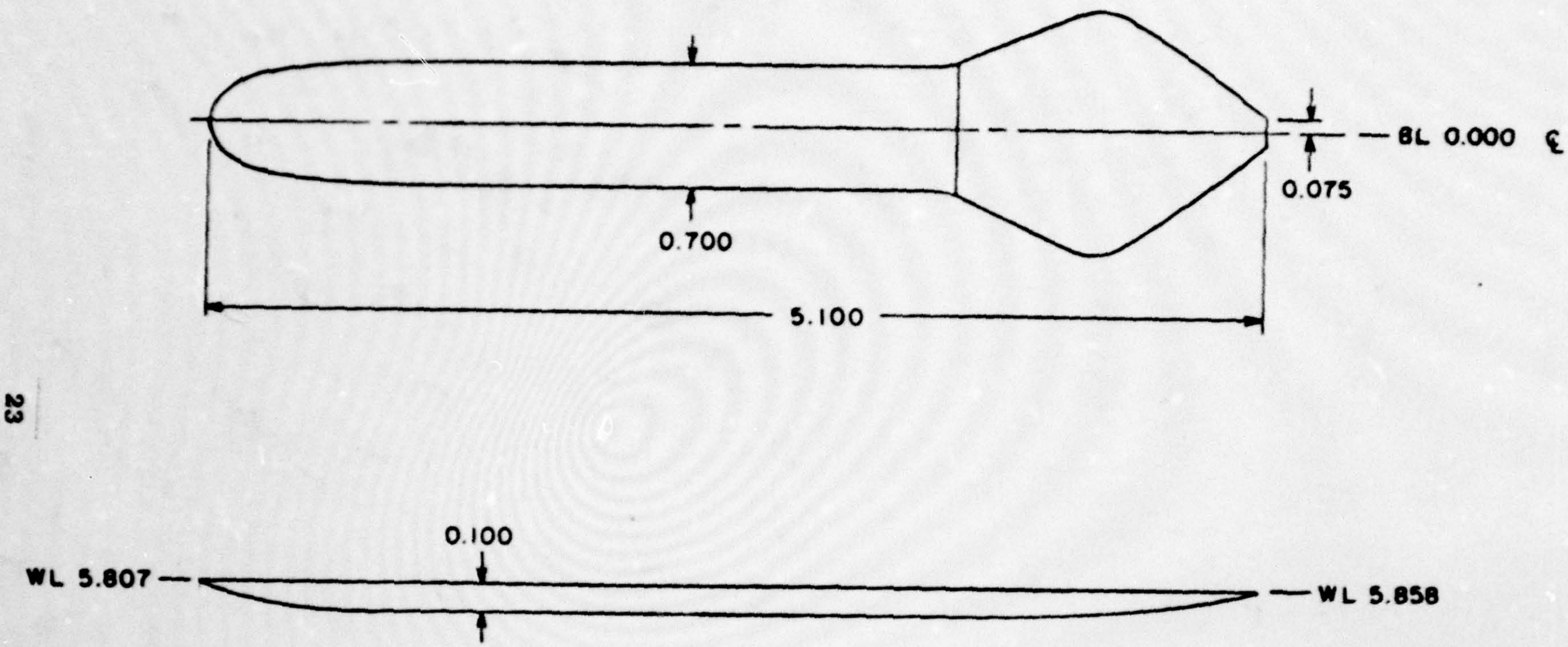
d. SUU-30H/B

Figure 4. Continued



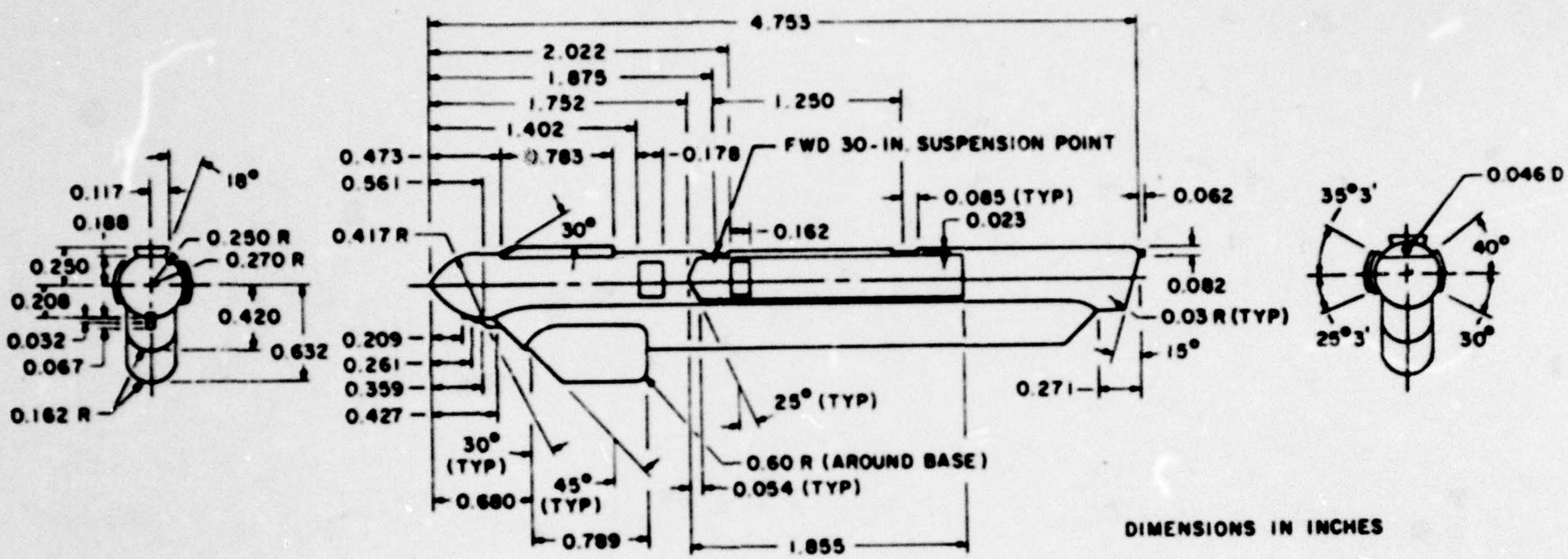
e. MK-20 Rockeye

Figure 4. Continued



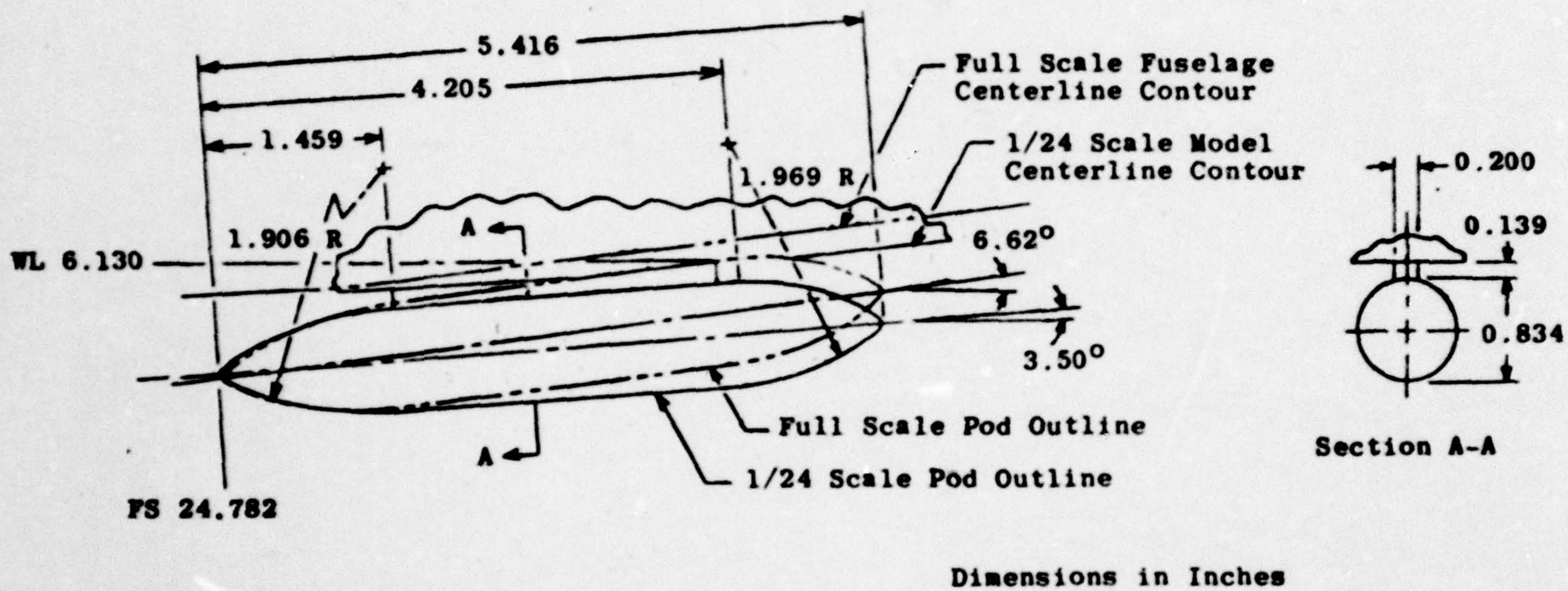
f. Retracted Pave Tack Pod

Figure 4. Continued



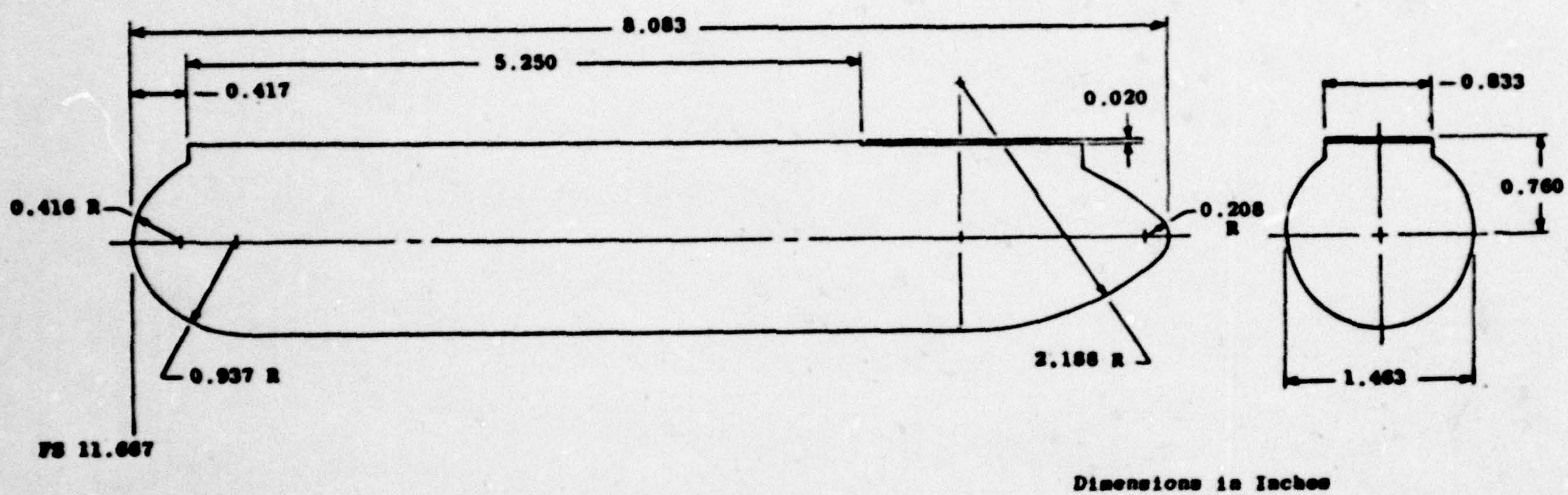
g. ALQ-119 Pod

Figure 4. Continued



h. Data Link Pod

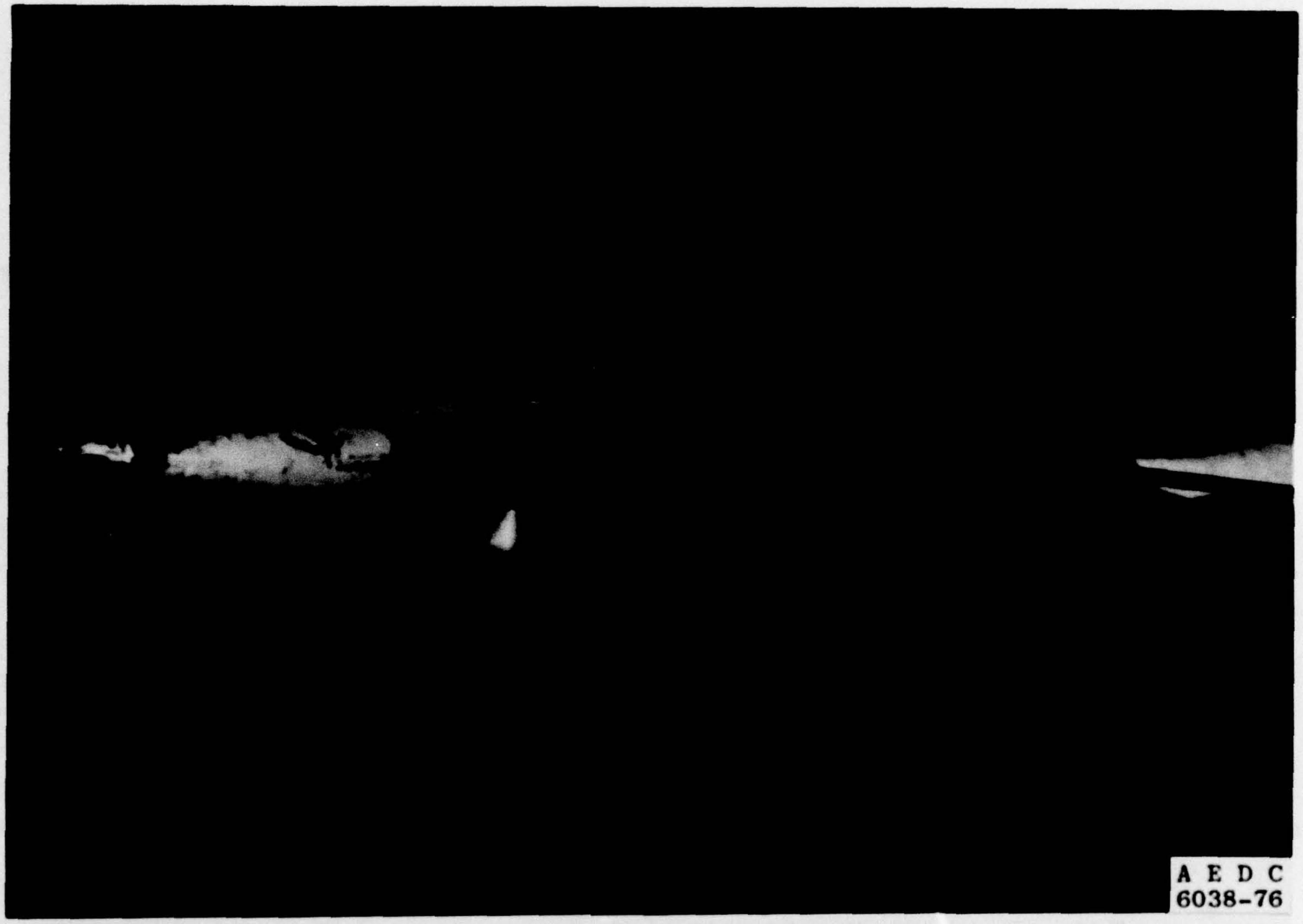
Figure 4. Continued



1. TAWDS Pod
Figure 4. Concluded

a. F-111 Model with Stores

Figure 5. Model Installed in Tunnel 4T

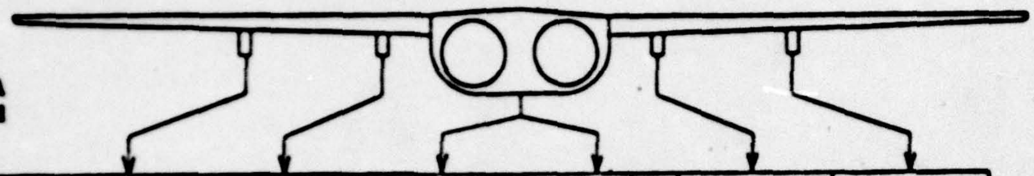


b. F-111 Model with TAWDS Pod

Figure 5. Concluded

Table 1. Model Configuration Identification

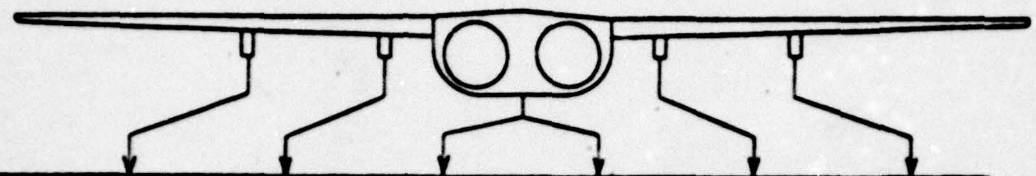
FWD } Denotes BRU-3A/A rack and load
AFT }



CONFIG. NO.	PYLON 3	PYLON 4	FORWARD CENTERLINE	AFT CENTERLINE	PYLON 5	PYLON 6
1	Clean	Clean	Clean	Clean	Clean	Clean
4	GBU-15 CWW	GBU-15 CWW	Clean	Clean	GBU-15 CWW	GBU-15 CWW
15	Empty	GBU-15 PWW	Retracted Pave Tack ALQ-119	Data Link Pod	GBU-15 PWW	GBU-15 PWW
16	BRU-3A/A 6 SUU-30	BRU-3A/A 4 SUU-30	Clean	Clean	BRU-3A/A 4 MK-20	BRU-3A/A 6 MK-20

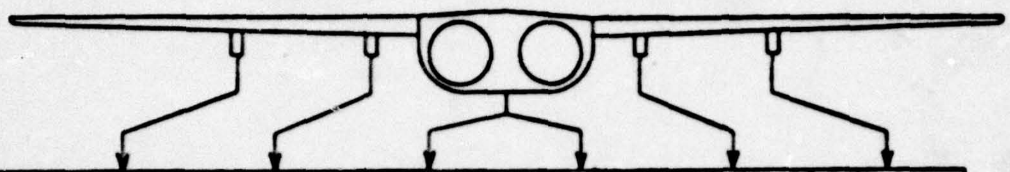
Clean - Denotes Pylon Removed
Empty - Denotes No Store and/or Ejector Rack on Pylon

Table 1. Continued



CONFIG. NO.	PYLON 3	PYLON 4	FORWARD CENTERLINE	AFT CENTERLINE	PYLON 5	PYLON 6
17	Empty	BRU-3A/A 4 MK-82SE	Clean	Clean	GBU-15 CWW	Empty
18	BRU-3A/A 6 MK-82SE	Empty	Clean	Clean	Empty	GBU-15 CWW
19	BRU-3A/A 6 MK-82SE	BRU-3A/A 4 MK-82SE	Clean	Clean	GBU-15 CWW	GBU-15 CWW
20	Clean	Clean	Tawds Pod	Clean	Clean	Clean

Table 1. Concluded



CONFIG. NO.	PYLON 3	PYLON 4	FORWARD CENTERLINE	AFT CENTERLINE	PYLON 5	PYLON 6
21	BRU-3A/A 6 MK-82SE	Pylon	Clean	Clean	Pylon	GBU-15 CWW
22	BRU-3A/A 6 MK-82SE	BRU-3A/A 4 MK-82SE	Clean	Clean	BRU-3A/A 4 MK-20	BRU-3A/A 6 MK-20

Table 2. Nominal Test Conditions

M	PT	P	Q	Re x 10^{-6}
0.40	1200	1075	120	1.4
0.60	↓	940	238	2.0
↓	2000	1566	394	3.1
0.80	1200	790	352	2.3
0.90	↓	710	402	2.5
0.95	↓	670	425	↓
1.05	↓	598	460	↓
↓	2000	999	768	4.0
1.20	1200	498	500	2.6

Table 3. Aircraft Aerodynamic Coefficient Uncertainties and Tunnel Condition Uncertainties

TUNNEL CONDITIONS and COEFFICIENTS		MACH NUMBER						
		0.40	0.60	0.80	0.90	0.95	1.05	1.20
M		±0.008	±0.006	±0.005	±0.004	±0.004	±0.004	±0.004
Q		±4.6	±3.9	±3.3	±2.9	±2.8	±2.4	±2.0
PT		±3.6	±3.6	±3.6	±3.6	±3.6	±3.6	±3.6
CLS	ALPHA = 0, BETA = 0	±0.029	±0.015	±0.010	±0.009	±0.008	±0.008	±0.007
	ALPHA = 15, BETA = 10	±0.051	±0.028	±0.015	±0.012	±0.011	±0.010	±0.008
CYS	ALPHA = 0, BETA = 0	±0.0125	±0.0064	±0.0043	±0.0038	±0.0035	±0.0033	±0.0030
	ALPHA = 15, BETA = 10	±0.0134	±0.0070	±0.0045	±0.0039	±0.0037	±0.0035	±0.0031
CDTS	ALPHA = 0, BETA = 0	±0.0039	±0.0020	±0.0013	±0.0012	±0.0011	±0.0011	±0.0010
	ALPHA = 15, BETA = 10	±0.0148	±0.0080	±0.0054	±0.0044	±0.0043	±0.0043	±0.0038
CLLS	ALPHA = 0, BETA = 0	±0.0013	±0.0007	±0.0005	±0.0004	±0.0004	±0.0004	±0.0003
	ALPHA = 15, BETA = 10	±0.0015	±0.0007	±0.0005	±0.0004	±0.0004	±0.0004	±0.0003
CLMTS	ALPHA = 0, BETA = 0	±0.0133	±0.0068	±0.0046	±0.0040	±0.0038	±0.0035	±0.0032
	ALPHA = 15, BETA = 10	±0.0142	±0.0081	±0.0047	±0.0049	±0.0048	±0.0048	±0.0040
CLNS	ALPHA = 0, BETA = 0	±0.0018	±0.0009	±0.0006	±0.0005	±0.0005	±0.0005	±0.0004
	ALPHA = 15, BETA = 10	±0.0018	±0.0009	±0.0006	±0.0005	±0.0006	±0.0005	±0.0004

Table 4. Typical Pylon-Mounted Store Coefficient Uncertainties

COEFFICIENT	MACH NUMBER					
	0.60	0.80	0.90	0.95	1.05	1.20
CNX(CNX = 0)	±0.135	±0.090	±0.079	±0.075	±0.069	±0.064
CNX(CNX = 4)	±0.150	±0.097	±0.084	±0.079	±0.072	±0.066
CYX(CYX = 0)	±0.117	±0.078	±0.069	±0.065	±0.060	±0.055
CYX(CYX = 4)	±0.135	±0.087	±0.075	±0.070	±0.064	±0.057
CLLX(CLLX = 0)	±0.173	±0.116	±0.101	±0.096	±0.089	±0.082
CLLX(CLLX = 4)	±0.185	±0.121	±0.106	±0.099	±0.091	±0.083
CLMX(CLMX = 0)	±0.102	±0.068	±0.060	±0.056	±0.052	±0.048
CLMX(CLMX = 4)	±0.122	±0.078	±0.067	±0.062	±0.056	±0.051
CLNX(CLNX = 0)	±0.200	±0.134	±0.117	±0.110	±0.103	±0.094
CLNX(CLNX = 4)	±0.211	±0.139	±0.121	±0.114	±0.105	±0.096

Table 5. Typical Rock-Mounted Store Coefficient Uncertainties

COEFFICIENT	MACH NUMBER					
	0.60	0.80	0.90	0.95	1.05	1.20
CNX(CNX = 0)	±0.034	±0.022	±0.020	±0.019	±0.017	±0.016
CNX(CNX = 1)	±0.038	±0.024	±0.021	±0.020	±0.018	±0.016
CYX(CYX = 0)	±0.029	±0.020	±0.017	±0.016	±0.015	±0.014
CYX(CYX = 1)	±0.034	±0.021	±0.019	±0.017	±0.016	±0.014
CLLX(CLLX = 0)	±0.022	±0.014	±0.013	±0.012	±0.011	±0.010
CLLX(CLLX = 1)	±0.027	±0.017	±0.014	±0.014	±0.012	±0.011
CLMX(CLMX = 0)	±0.013	±0.009	±0.007	±0.007	±0.007	±0.006
CLMX(CLMX = 1)	±0.021	±0.013	±0.010	±0.010	±0.008	±0.007
CLNX(CLNX = [illegible])	±0.024	±0.017	±0.015	±0.014	±0.013	±0.012
CLNX(CLNX = 1)	±0.030	±0.019	±0.016	±0.015	±0.014	±0.012

Table 6. Summary of Test Program

Conf	Store Loading	Wing Sweep	Stab	Speed Brake	ALPHA	BETA	Mach Number 0.40	0.60	0.80	0.90	0.95	1.05	1.20
1	Clean	26	0	0	A	0	593	600	607		614	621	
					6	B	594	601	608		615	622	
					10		595	602	609		616	623	
					12.5		596	603	610		617		
					15		597	604	611		618	624	
					17.5		598	605	612		619		
					20		599	606	613		620		
			-10	0	A	0	628	629	630		631	632	
			10	0			636	637	638		639	640 642	
		54	0	0				570	571	572	576	580	587
					6	B				573	577	581	588
					10					574	578	582	589
					15					575	579		
			-10	0	A	0		559	560	561	562	563	565
			10	0				554	555	551 552	553		
4	Pylon 3 GBU-15CWW Pylon 4 GBU-15CWW Pylon 5 GBU-15CWW Pylon 6 GBU-15CWW	26	0	0				15 16 | 20	24 25 | 26		33 34 | 35	39 40 | 41	
					6	B		21	27		36	42	
					10			22	28		37	43	
					15			23	29		38	44	
			-10	0	A	0		49	50		51	52	
			10	0				58	59		60	61	

ANGLE OF ATTACK SCHEDULES

A -2,0,2,4,6,8,10,12,14,16,18,20,22,24

A1 -2,0,2,4,6,8,10,12,14,16,18,20,22,24,22,20,18,16,14,12,10,8,6,4,2,0,-2,0

ANGLE OF SIDESLIP SCHEDULE

B -10,-8,-6,-4,-2,0,2,4,6,8,10

B1 0,-2,-4,-6,-8,-10,-8,-6,-4,-2,0,2,4,6,8,10,8,6,4,2,0,-2,-4,-6,-8,-10,-8,-6,-4,-2,0

Table 6. Continued

Conf	Store Loading	Wing Sweep	Stab	Speed Brake	ALPHA	BETA	Mach Number 0.40	0.60	0.80	0.90	0.95	1.05	1.20
4	Pylon 3 GBU-15 CWW	54	0	0	A	0				519/515, 516	520	524	528
	Pylon 4 GBU-15CWW				6	B				517	521	525	529
	Pylon 5 GBU-15CWW				10					518	522	526	530
	Pylon 6 GBU-15 CWW				15					-		527	531
					20					519	523		
			-10	0	A	0				535	536	537	538
			10	0						542	543/544	545	546
15	Pylon 3 Empty Pylon 4 GBU-15 PWW Pylon 5 GBU-15 PWW Pylon 6 GBU-15 PWW FWD C.L. Ret. Bve Tx, ALQ119 AFT C.L. Data Link Pod	26	0	0				182	186		190	194	
					-1	B		183	187		191	195	
					4			184	188		192	196	
					9			185	189		193	197	
16	Pylon 3 BRU-3, 6SUU 30 Pylon 4 BRU-3, 4SUU 30 Pylon 5 BRU-3, 4 MK 20 Pylon 6 BRU-3, 6 MK 20	26	0	0	A	0		157	161		165	169	
					6	B		158	162		166	170	
					10			159	163		167	171	
					20			160	164		168	172	
		54	0	0	A	0		375	379		383	387	391
					6	B		376	380		384	388	392
					10			377	381		385	389	393
					15							396	394
					20			378	382		386		
17	Pylon 3 Empty Pylon 4 BRU-3, 4MK-82 Pylon 5 GBU-15 CWW Pylon 6 Empty	26	0	0	A1	0		67	71		75	79	
					5.8	B1		68	72		76	80	
					10			69	73		77	81	
					20			70	74		78	82	

Table 6., Continued

Conf	Store Loading	Wing Sweep	Stab	Speed Brake	ALPHA	BETA	Mach Number 0.40	0.60	0.80	0.90	0.95	1.05	1.20
17	Pylon 3 Empty Pylon 4 BRU-3, 4MK82 Pylon 5 GBU-15 CWW Pylon 6 Empty	54	0	0	A	0		400	404		408	412	416
					6	B		401	405		409	413	417
					10			402	406		410	414	418
					15							415	419
					20			403	407		411		
18	Pylon 3 BRU-3, 6MK82 Pylon 4 Empty Pylon 5 Empty Pylon 6 GBU-15 CWW	26	0	0	A1	0		87	91		95 / 96	101	
					6	B1		88	92		97	102	
					10			89	93		98	103	
					15						100		
					20			90	94			104	
		54	0	0	A	0		489	493		497	501	505
					6	B		490	494		498	502	506
					10			491	495		499	503	507
					15							504	508
					20			492	496		500		
				50	A	0		468	472		476	480	
					6	B		469	473		477	481	
					10			470	474		478	482	
					15							485	
					20			471	475		479	-	
		60	0	0	A	0		346	350		354	358	363
					6	B		347	351		355	360	364
					10			348	352		356	361	365
					15							362	366
					20			349	353		357		

Table 6. Continued

Conf	Store Loading	Wing Sweep	Stab	Speed Brake	ALPHA	BETA	Mach Number 0.40	0.60	0.80	0.90	0.95	1.05	1.20
18	Pylon 3 BRU-3, 6 MK82	72.5	0	0	A	0			236		245	250, 251	256
	Pylon 4 Empty				6	B			237		246	253	258
	Pylon 5 Empty				10				238, 243		247	254	259
	Pylon 6 GBU-15 CWW				15							255	260
					20				244		249		
				50	A	0			265		269	274	278
					6	B			266		270	275	279
					10				267		271	276	280
					15							277	281
					20				268		273		
19	Pylon 3 BRU-3, 6 MK82	26	0	0	A1	0		109	113		119	128	
	Pylon 4 BRU-3, 4 MK82							135*				136*	
	Pylon 5 GBU-15 CWW				6	B1		110	114		122	129	
	Pylon 6 GBU-15 CWW				10			111	115		123	130	
					15						127	132	
					20			112	116		125	131	
		45	0	0	A	0		203	207, 208		213	218, 220	224, 225, 226
					6	B		204	209		214	219, 221	227
					10			205	210		215	222	228
					15							223	229
					20			206	211		217		

* PT = 2000 psfa

Tanle 6. Continued

Conf	Store Loading	Wing Sweep	Stab	Speed Brake	ALPHA	BETA	Mach Number 0.40	0.60	0.80	0.90	0.95	1.05	1.20
19	Pylon 3 BRU-3, 6 MK82 Pylon 4 BRU-3, 4 MK82 Pylon 5 GBU-15 CWW Pylon 6 GBU-15 CWW	54	0	0	A1	0		424	430		434	438	442
					6	B1		425	431		435	439	443
					10			426	432		436	440	444
					15			429	433		437	441	445
					20			427 428					
				50	A	0		449	453		457	461	
					6	B		450	454		458	462	
					10			451	455		459	463	
					15							464	
					20			452	456		460		
		60	0	0	A	0		320	324	328	329	333	337
					6	B		321	325		330	334	338
					10			322	326		331	335	339
					15							336	340
					20			323	327		332		
20	Wing - Clean FWD CL TAWDS POD	26	0	0	A	0	646	653	660		667	675	
					6	B	647	654	661		668	676	
					10		648	655	662		669	677	
					12.5		649	656	663		670		
					15		650	657	664		671	678	
					17.5		651	658	665		673		
					20		652	659	666		674		
			-10	0	A	0	682	683	684		685		
			10	0			689	690	691		692		

Table 6. Concluded

Conf	Store Loading	Wing Sweep	Stab	Speed Brake	ALPHA	BETA	Mach Number 0.40	0.60	0.80	0.90	0.95	1.05	1.20
21	Pylon 3 BRU-3, 6SUU30	92.5	0	0	A	0			286		296	303	309
	Pylon 4 Empty				6	B			287		297	304	310
	Pylon 5 Empty				10				288		298	305	311
	Pylon 6 BRU-3, 6Mk20				15							306	312
					20				289		299		
22	Pylon 3 BRU-3, 6Mk82	26	0	0	A	0		142					
	Pylon 4 BRU3, 4Mk82				6	B		143					
	Pylon 5 BRU3, 4Mk20												
	Pylon 6 BRU3, 6Mk20												

Table 7. Sample Tabulated Data Format

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DATE 19-JUL-79    PROJECT NO P41C-C4C
ARO, INC.
AEDC DIVISION
A SVERDRUP CORPORATION COMPANY
PROPULSION WIND TUNNEL
ARNOLD AIR FORCE STATION, TENNESSEE

  TEST  593  PART 692                          APATL F-111 AIRLOADS TEST
  SUMMARY   1         PYLON 3     PYLON 4    FWD  CL     AFT  CL       PYLON 5     PYLON 6      TRANSONIC  4T
                       CLEAN       CLEAN     TANDS POD   CLEAN          CLEAN       CLEAN
```

PART	MACH	Q	Rel0-6	PT	P	TT	CONFIG NO.	SWEEP	SPEED BRAKE	STABILATOR	AFA	CONSPT
692	0.952	418.6	2.4010	1102.5	660.3	94.0	20.	26.0	0.	10.	0.151	72.

TP	ALPHA	BETA	CN	CY	CAT	CLL	CLMT	CLN	CA	CAB	PCAV	PB1	PB2	PTE1	PTE2
3	-1.97	0.05	-0.102	-0.0016	0.1002	-0.0033	-0.3007	-0.0004	0.1039	0.0044	622.9	591.9	593.5	1139.7	1140.5
4	0.05	0.05	0.072	-0.0023	0.1061	0.0011	-0.3091	-0.0002	0.1013	0.0049	621.4	591.1	592.0	1124.9	1134.2
5	2.00	0.05	0.280	-0.0036	0.1040	0.0008	-0.3307	-0.0001	0.0991	0.0049	624.1	595.0	595.4	1102.5	1110.3
7	4.01	0.05	0.502	-0.0037	0.1002	-0.0001	-0.3911	-0.0000	0.0954	0.0048	630.4	602.6	602.9	1087.4	1094.3
10	6.02	0.05	0.770	-0.0050	0.0999	0.0005	-0.4829	0.0002	0.0952	0.0048	630.0	601.2	600.8	1097.3	1102.2
12	8.03	0.05	1.004	-0.0056	0.0950	-0.0014	-0.5482	0.0005	0.0916	0.0042	633.0	602.5	602.9	1102.7	1104.6
14	10.00	0.05	1.179	-0.0060	0.0912	-0.0022	-0.5828	0.0006	0.0867	0.0044	625.8	595.6	595.4	1112.1	1106.5
17	12.03	0.05	1.359	-0.0067	0.0905	0.0010	-0.6358	0.0005	0.0858	0.0047	623.6	595.3	593.8	1127.2	1108.7

Table 7 Continued

DATE 19-JUL-79   PROJECT NO P41C-C4C
ARO, INC.
AEDC DIVISION
A SVERDRUP CORPORATION COMPANY
PROPULSION WIND TUNNEL
ARNOLD AIR FORCE STATION, TENNESSEE

TEST 593 PART 692   AFATL F-111 AIRLOADS TEST
SUMMARY 2   PYLON 3 CLEAN   PYLON 4 CLEAN   FWD CL TAWDS POD   AFT CL CLEAN   PYLON 5 CLEAN   PYLON 6 CLEAN   TRANSONIC 4T

PART	MACH	Q	RE*10-6	PT	P	TT	CONFIG NO.	SWEEP	SPEED BRAKE	STABILATOR	APA	CONSET
692	0.952	418.6	2.4010	1182.5	860.3	94.0	20.	26.0	0.	10.	0.191	72.

TP	ALPHA	BETA	CLS	CYS	CDTS	CLLS	CLMTS	CLNS	CDS	CDR	NCP
3	-1.97	0.05	-0.090	-0.0016	0.1117	-0.0033	-0.3007	-0.0005	0.1073	0.0044	3.0605
4	0.05	0.05	0.072	-0.0023	0.1062	0.0011	-0.3091	-0.0002	0.1013	0.0049	-4.3236
5	2.00	0.05	0.276	-0.0036	0.1141	0.0008	-0.3387	-0.0001	0.1092	0.0049	-1.2766
7	4.01	0.05	0.494	-0.0037	0.1352	-0.0007	-0.3911	-0.0000	0.1304	0.0048	-0.7916
10	6.02	0.05	0.755	-0.0050	0.1801	0.0005	-0.4829	0.0002	0.1753	0.0048	-0.6397
12	8.03	0.05	0.901	-0.0056	0.2351	-0.0013	-0.5402	0.0007	0.2310	0.0041	-0.5588
14	10.00	0.05	1.145	-0.0068	0.2944	-0.0021	-0.5828	0.0010	0.2900	0.0044	-0.5090
17	12.03	0.05	1.310	-0.0067	0.3717	0.0011	-0.6358	0.0003	0.3671	0.0046	-0.4854

Table 7 Continued

DATE 19-JUL-79 PROJECT NO P41C-C4C
ARO, INC.
AEDC DIVISION
A SVERDRUP CORPORATION COMPANY
PROPULSION WIND TUNNEL
ARNOLD AIR FORCE STATION, TENNESSEE

TEST 593 PART 692 AFATL F-111 AIRLOADS TEST
SUMMARY 3

PYLON 3	PYLON 4	FWD CL	AFT CL	PYLON 5	PYLON 6	TRANSONIC 4T
CLEAN	CLEAN	TANDS POD	CLEAN	CLEAN	CLEAN	

PART	MACH	Q	R*10-6	PT	P	TT	CONFIG NO.	SWEEP	SPEED BRAKE	STABILATOR	AFA	CONSET
692	0.952	418.6	2.4010	1182.5	660.3	94.0	20.	26.0	0.	10.	0.151	72.

TP	ALPHA	BETA	CN3	CY3	CLL3	CLM3	CLN3	CN4	CY4	CLL4	CLM4	CLN4
3	-1.97	0.05	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4	0.05	0.05	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
5	2.00	0.05	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
7	4.01	0.05	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
10	6.02	0.05	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
12	8.03	0.05	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
14	10.00	0.05	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
17	12.03	0.05	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Table 7 Concluded

DATE 19-JUL-79 PROJECT NO P41C-C4C
ARO, INC.
AEDC DIVISION
A SVERDRUP CORPORATION COMPANY
PROPULSION WIND TUNNEL
ARNOLD AIR FORCE STATION, TENNESSEE

TEST 593 PART 692			AFATL F-111 AIRLOADS TEST				
SUMMARY 4	PYLON 3 CLEAN	PYLON 4 CLEAN	FWD CL TAWDS POD	AFT CL CLEAN	PYLON 5 CLEAN	PYLON 6 CLEAN	TRANSONIC 4T

PART	MACH	Q	Re*10-6	PT	P	TT	CONFIG NO.	SWEEP	SPEED BRAKE	STABILATOR	AFA	CONSET
692	0.952	419.6	2.4010	1182.5	660.3	94.0	20.	26.0	0.	10.	0.151	72.

TP	ALPHA	BETA	CN5	CY5	CLL5	CLM5	CLN5	CN6	CY6	CLL6	CLM6	CLN6
3	-1.97	0.05	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4	0.05	0.05	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
5	2.00	0.05	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
7	4.01	0.05	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
10	6.02	0.05	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
12	8.03	0.05	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
14	10.00	0.05	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
17	12.03	0.05	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000